SPONGES OF THE LOW ISLES, GREAT BARRIER REEF: AN IMPORTANT SCIENTIFIC SITE, OR A CASE OF MISTAKEN IDENTITY ?

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Much of our early, reliable scientific knowledge on marine taxonomy, biological and other processes of coral reefs in general, and the Great Barrier Reef (GBR) in particular, comes from the 1928-29 GBR Expedition based on the Low Isles. 106 species of sponges were collected from northern reefs of the GBR Expedition and described by Burton in 1934, 36 from the Low Isles. Burton concluded that the sponge fauna contained: 'species characteristic of the Indo-Pacific' (38% of his species); many 'common also to the coasts of Australia' (17%) 'with a mixing of the Australian and Malayan sponge-faunas'; substantial cosmopolitanism (12%) with species 'also found in the West Indies, Azores and Mediterranean'; and only few indigenous species (14% unique to the Low Isles, 19% exclusive to N Australia). Re-examination of BMNH voucher and type material found 42% of these species were misidentified, mainly concerning the so-called 'widely distributed' taxa. Recent collections from the Low Isles by the Queensland Museum (QM) discovered 109 species, and together with the revised Burton collection indicate a sponge fauna of 134 species (in 63 genera and 35 families). Surprisingly only 12 species (9% of the Low Isles fauna) were common to both the Burton and QM collections. Taxonomic comparisons with other provinces show several major trends for Low Isles sponges: 1) The fauna contains a generalist element comprising 'typical GBR species', found on virtually all reefs surveyed so far (23% of Low Isles species). 2) The fauna also contains an indigenous component of species unique to the northern GBR (48% of Low Isles species), with 32% of these not yet recorded from anywhere else, and another 16% known only from both the Low Isles and Lizard Island (200km to the north). 3) Affinities with coastal faunas are low, contrary to Burton's hypothesis, with only 13% of Low Isles species also found on adjacent coastal regions. 4) Affinities with oceanic coral reef species are also low, with only 10% of Low Isles species found on the Coral Sea seamounts. 5) The concept of an 'east Australian coast' sponge fauna is not supported, contrary to both earlier collections described by Lendenfeld in 1888 and 1889, and Burton, with only 10% of Low Ises species extending southwards into more temperate Queensland waters, and only 2% extending further into southern New South Wales. 6) The concept of 'cosmopolitan' species is unsubstantiated. ☐ *Porifera, Low Isles, Great Barrier Reef, faunal survey, biodiversity, biogeography, taxonomy.*

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The Low Isles, Cairns Section, Great Barrier Reef (GBR), is an historically important site for coral reef research in Australasia, being the base for the 1928-29 Great Barrier Reef Expedition. These islands (16°23'S, 145°34'E) lie about 15km off the coast of far northern Queensland, 70km N of Cairns, approximately midway between the mainland and outer barrier reef (Fig. 1A), and easily accessible from both Port Douglas and Cairns. They consist of two small coral islets (Fig. 1B), one with a sand cay and the other a coral 'shingle' islet with mangroves, both with extensive fringing reef and connected by an expansive coralline reef flat. The geomorphology and many other aspects of these reefs have been described in detail in the *Scientific Reports of the Great Barrier Reef Expedition 1928-29*.

Since at least the 1880s these small islands have been frequented by recreational and commercial fishermen, tourists and government authorities (e.g. meteorological bureau, coast-watch, and scientists). The islands owe their

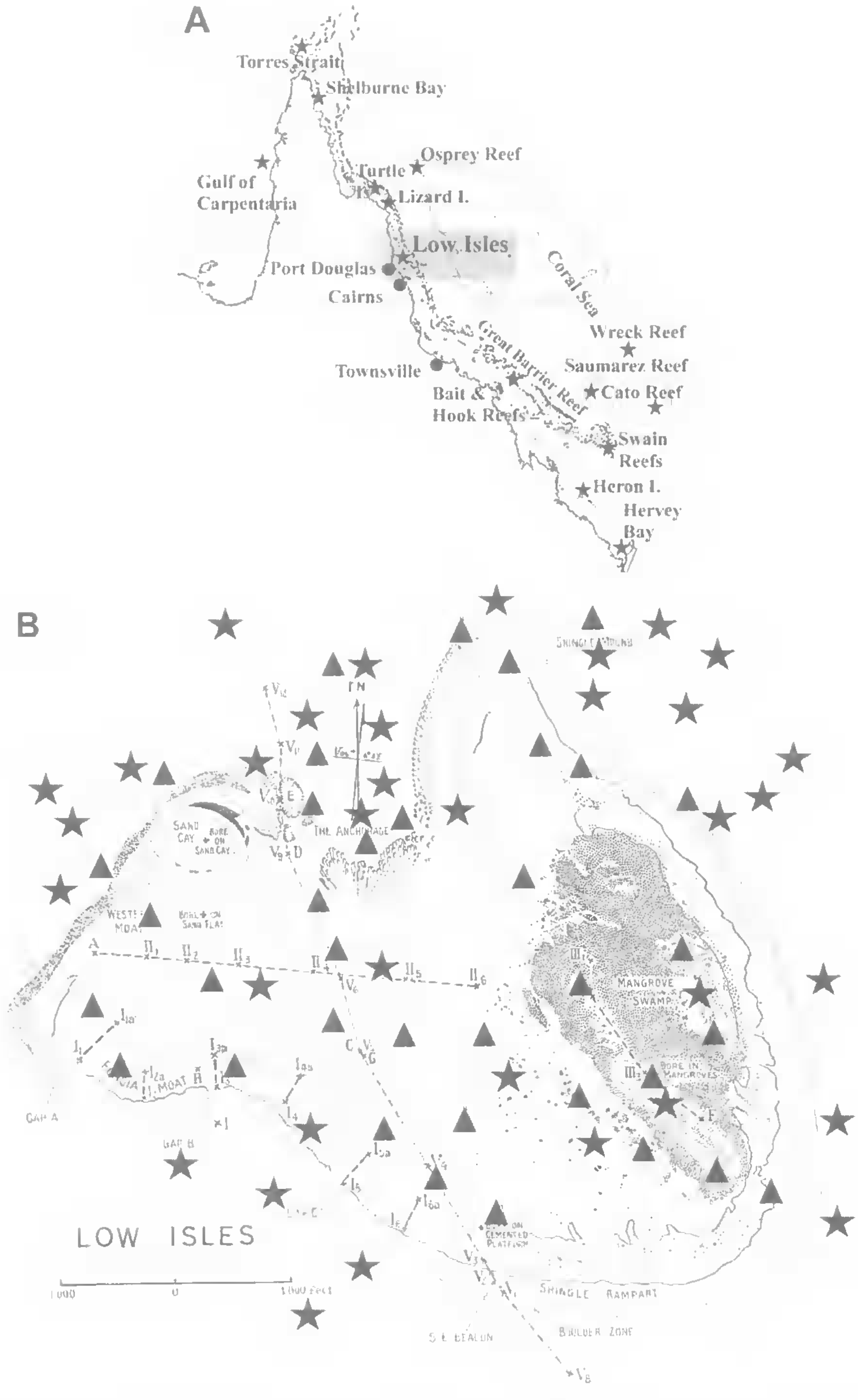

FIG. 1. A, Location of the Low Isles on the GBR and other localities mentioned in the text (dots indicate adjacent coastal settlements; stars indicate sites of major sponge collections undertaken by the QM). B, Low Isles (from Stephenson et al., 1931), showing collection localities of the 1928-29 expedition (triangles; taken from Burton's text) and 1997 QM expedition (stars).

popularity largely to their close proximity to human settlement, their wide variety of habitat types (typical of the chain of about 50 low woody islets on the far northern sector of the GBR, of which the Low Isles are the most southern), including sandy beaches, a vegetated sand cay, extensive coral reef flat and lagoon, fringing reefs, and large stands of 'uninhabitable mangrove swamp' (Yonge, 1928), as well as a permanent settlement on the sand cay since 1878 associated with the operation and maintainance of the lighthouse — now a heritage listed building (Anon., 1993).

Between the early 1880s and the early 1900s William Saville-Kent and Robert von Lendenfeld actively collected and described sponges from far northern Queensland. Unfortunately, neither author provided specific or reliable locality or habitat data, with the exception of collections made during the pearl oyster surveys off Cape York in the late 1800s (in which case the locality 'Torres Strait' was usually quoted). Where locality data did exist on specimen labels it was often contradicted in the corresponding museum register and again in the published records, and therefore all of these data must be treated as suspect (Hooper & Wiedenmayer, 1994). Nevertheless, it is likely that some of their material was collected from reefs in the vicinity of Cairns and Port Douglas given the close proximity of the GBR to the coast in this region, and the popularity of these reefs. Their collections were deposited in both the Natural History Museum, London (BMNH), and Australian Museum, Sydney (AM), but much of this early material is dry and virtually useless for modern taxonomic determination.

In 1925 the Great Barrier Reef Committee proposed a concerted program to explore the 'origin, growth and natural resources of the Great Barrier Reef' (Yonge, 1928), with the Low Isles subsequently chosen as the site for a major expedition to undertake in situ studies of coral reefs and their processes, led by C.M. Yonge. The expedition remained on the Low Isles for just over twelve months during 1928-29. During this time they surveyed most of the available habitats on and surrounding the two islands of the Low Isles (Stephenson et al., 1931). From Stephenson's description of sampling localities and methods, this effort was rigorous and comprehensive, even by today's standards. Collection of biological samples included reef-walking, dredging and diving via surface supply air (SSA) ('tin-hat' diving).

The *Scientific Reports of the Great Barrier Reef Expedition 1928-29* (British Museum (Natural History): London), were published in six volumes between 1928 and 1950, representing the most comprehensive study on coral reef biology, physics, chemistry and geology of the GBR system at that time, and perhaps of coral reefs in general. The sponge fauna from this expedition was published by Burton (1934), who described 36 species from the Low Isles and another 70 species from coral reefs and inter-reef habitats further north (mostly in the vicinity of Lizard I.). Discounting the publications from the 'Alert' (Ridley, 1884) and 'Challenger' expeditions (e.g. Ridley & Dendy, 1887), which mostly concerned the coast and islands of the Torres Straits and not the GBR proper, Burton was the first author to provide accurate locality and habitat data for GBR species, unlike his predecessors Saville-Kent and Lendenfeld. It was not until 35 years later that Bergquist (1969) published the next paper on GBR sponges, and another 10 years after that with the subsequent work of Wilkinson (1978). These latter publications described only a few intertidal and shallow subtidal species, from the southern end of the GBR (Heron I.), and consequently Burton's (1934) species have stood for over 50 years as being 'typical' or 'representative' of the entire GBR. Until this current decade his work has represented virtually the sum-total of our knowledge of the GBR sponge fauna.

Burton's (1934) species were divided into two groups: 1) 'Common Indo-Malay', with 'Indo-Malayan' species (38% of his collections), allegedly 'cosmopolitan' species (12%), and 'typical east Australian coast' species (17%); and 2) 'Indigenous', with apparent 'endemic' species (14%), and exclusively northern Australian species (19%), described from one or only few localities. Of the former group he rarely provided descriptions or referred to any museum voucher specimen to validate his identifications; of the latter group only relatively few have been subsequently recollected or redescribed in the literature (e.g. de Laubenfels, 1954), some of which we suspect, or now know, are misidentifications.

It was the intention of this study, therefore, to revisit the Low Isles to: 1) 'Rediscover' Burton's GBR species, locate and re-examine his voucher specimens (if they existed), of the allegedly 'cosmopolitan' species in particular, and ultimately to assign Burton's species names to

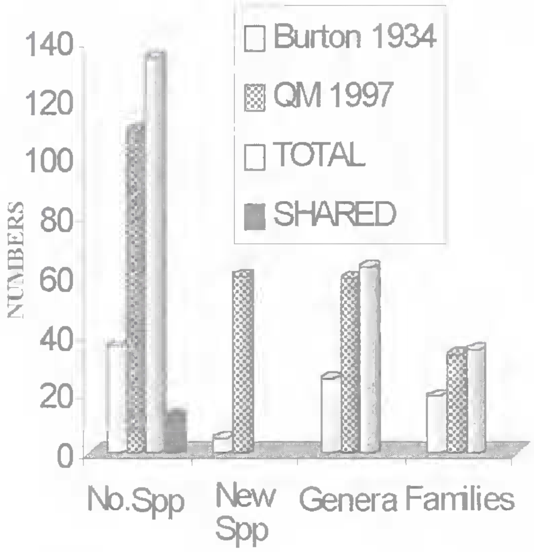

FIG. 2. Comparison of species diversity and taxonomic composition between Low Isles sponges collected by the GBR Expedition 1928-29 (Burton, 1934) and collections of the QM in 1997, indicating the total number of species collected (and species common to both expeditions), the number of new (or unnamed) species, numbers of genera and families.

living populations — a theoretically simple but practically elusive task for many Australian sponge faunas. 2) Compare sponge biodiversity and species composition between the Low Isles and other reefs of the GBR from our contemporary collections (see Fig. 1A), to ascertain whether this fauna is indeed representative of the GBR fauna in general as has been interpreted by many contemporary authors. To achieve these aims, without having to revise the entire northern GBR fauna, we restricted this study to include only the Low Isles, ignoring for the time being those species Burton described from the more northern reefs of Eagle, Direction, Lizard, Turtle and Howick Is.

MATERIALS AND METHODS

All sponges were collected using SCUBA, by hand for the intertidal fauna, or a small dredge for deeper subtidal soft-bottom species. All specimens are housed in the permanent collections of the QM (prefix QMG). Methods of preservation, histological preparation and taxonomic identification are published elsewhere (e.g. Hooper, 1996). Abbreviations: BMNH, The Natural History Museum, London; GBRMPA, Great Barrier Reef Marine Park Authority; QM, Queensland Museum, Brisbane; SSA, surface supplied air.

RESULTS AND DISCUSSION

BIODIVERSITY. The published sponge fauna of the entire Queensland region, including coastline, Great Barrier Reef, Queensland Plateau, and the Coral Sea, so far consists of only 428 named species and subspecies (Hooper & Wiedenmayer, 1994, including literature updated since 1994). Fewer than this, perhaps 250 named species, actually belong to the GBR fauna, with the remainder restricted to coastal waters, soft sediments in the Gulf of Carpentaria, the inter-reef region in the Torres Straits, and deeper-waters off the continental shelf. Recent collections by the QM from the GBR have subsequently recorded 507 species, many of which are probably new to science (Hooper et al., 1999, this volume).

Since Burton's (1934) work there were no subsequent publications of GBR sponges until Bergquist's (1969) description of a small intertidal collection from Heron I. Since Bergquist (1969), only relatively few other publications containing descriptions or redescriptions of GBR sponges have appeared, although these seem to be slowly escalating, perhaps reflecting the renewed interest in the phylum and in biodiversity in general (Wilkinson, 1978; Ayling, 1982; Pultizer-Finali, 1982; Thompson et al., 1987; Hooper, 1987, 1990, 1991, 1996; Bergquist et al., 1988; Stoddart, 1989; Wilkinson & Cheshire, 1989; Fromont, 1989, 1991, 1993, 1995; Van Soest et al., 1991; Hooper & Bergquist, 1992; Reitner, 1992; Hooper et al., 1993; Hooper & Lévi, 1993a, b, 1994; Van Soest & Hooper, 1993; Fromont et al., 1994; Bergquist, 1995; Bergquist & Kelly-Borges, 1995; Kelly-Borges & Vacelet, 1995; Reitner & Woerheide, 1995; Van Soest et al., 1996; Reitner et al., 1997).

Burton (1934) recorded 36 species from the Low Isles, collected over a 12 month period by the GBR Expedition, consisting of 5 new species, 25 genera and 19 families. By comparison, collections made by the Queensland Museum in 1997 over 7 days, from similar habitats encircling the islands as described by Stephenson et al. (1931), yielded 109 species (in 59 genera and 33 families; Fig. 2), of which only 46 (42%) can be accurately assigned to a known species — i.e. the remainder are possibly new to science or perhaps belong to species described by Lendenfeld (1888, 1889) but whose identity is still a 'mystery'

(Hooper & Wiedenmayer, 1994). Surprisingly, only 12 species were common to both the Burton and QM collections from the Low Isles (although we also collected another 12 species from the Low Isles that were reported by Burton (1934) from the GBR Expedition collections made at Lizard, Turtle and Direction Islands, but not previously found on the Low Isles).

In order to verify conspecificity between these two collections we undertook a search for Burton's (1934) Low Isles voucher specimens in the BMNH, of which all but three species were found (Table 1). Re-examination of this material found 15 species (42%) were misidentified, 12 belonging to completely different species than supposed by Burton (1934), and 3 split into different species (i.e. allopatric sibling species, as opposed to so called 'widespread' species); 1 is uncertain (i.e. the voucher specimen is missing and no description was provided by Burton); and 14 are transferred to other genera (based on more recent systematic revisions). Most of these 15 misidentified species were assigned by Burton (1934) to species that had 'wide Australian distributions' (i.e. temperate Australian, Northern Territory, and/or tropical Western Australian), 'widespread Indo-Pacific' (e.g. Indo-Malay archipelago, Sri Lanka and W Indian Ocean), or 'cosmopolitan species' (e.g. Mediterranean, Caribbean, Atlantic). These misidentifications were detected and confirmed by comparing Burton's samples with the type material (and/or contemporary specimens) of his named species from these other localities (QM and BMNH collections).

Quantitative differences in species diversity between the GBR Expedition (36 spp.) and QM collections (109 spp.) are not surprising given the greater technological advances made in contemporary collecting techniques (SCUBA, underwater photography), and the probable ineffectual use of generalist (non-specialist) biological collectors to undertake sponge faunal surveys, irrespective of the substantial differences between time scales of two collections (12 months versus 7 days duration, respectively). For example, Burton (1934) described *Raphidotethya enigmatica* and recorded *Ianthella flabelliformis* from more northerly reefs in the Lizard Island region (but not from the Low Isles), whereas we found both these species were relatively common on the Low Isles subtidal reefs. It is possible (but not explicit in their reports), that the GBR Expedition did not commonly use SSA and dredging around the Low Isles themselves (whereas we do know they used these techniques on the more northerly reefs), and it is likely that many or most of the Low Isles sponges were collected from the intertidal reef flat (Fig. 1B).

Thus, based on the recent QM collections and the revised Burton (1934) collections, the total species diversity for the Low Isles now consists of 134 species (in 63 genera and 35 families) (Fig. 2).

SPECIES COMPOSITION. The low similarity in species composition between the GBR Expedition and QM sponge collections is more surprising. Only 12 species or 33% of Burton's (1934) published fauna were common to both collections, consisting mainly of widespread GBR species (e.g. *Druinella purpurea*, *Carteriospongia foliascens*, *Haliclona cymaeformis*, *Cinachyra australiensis*). Several explanations are apparent. 1) Perhaps the more recent QM collection did not find the other 66% of Burton's (1934) species because of the shorter time-scale for collection (7 days versus 12 months), whereby these other species might represent the rare or cryptic species? This explanation is highly unlikely, however, given that we have found some of Burton's Low Isles species elsewhere on the GBR, from collections of similar duration, and in some cases (e.g. *Spirastrella inconstans*, *Callyspongia diffusa*) these species are common. 2) It is also possible that the GBR Expedition mainly, or perhaps exclusively, targetted the easily accessible intertidal fauna, whereas QM collections were predominantly (although not exclusively) subtidal. 3) Nevertheless, there are several species (particularly some of the *Haliclona* and *Callyspongia* described by Burton) which are common on the intertidal reef flats of other reefs on the GBR, but apparently not present on the Low Isles today. It is possible that some of these species may be 'locally extinct' due to anthropogenic or natural causes.

Burton's (1934) misidentifications are less easily explained. Burton had ready access to the vast BMNH collections, containing types, fragments, or representative samples of most species known at that time from the Australian, Oriental, Afrotropical, Neotropical and Palaearctic provinces, yet 42% of his species are not conspecific with these allegedly 'widely distributed' or 'cosmopolitan' species. For example, Burton recorded *Jaspis stellifera* from the Low Isles, noting that it did not contain asters, whereas

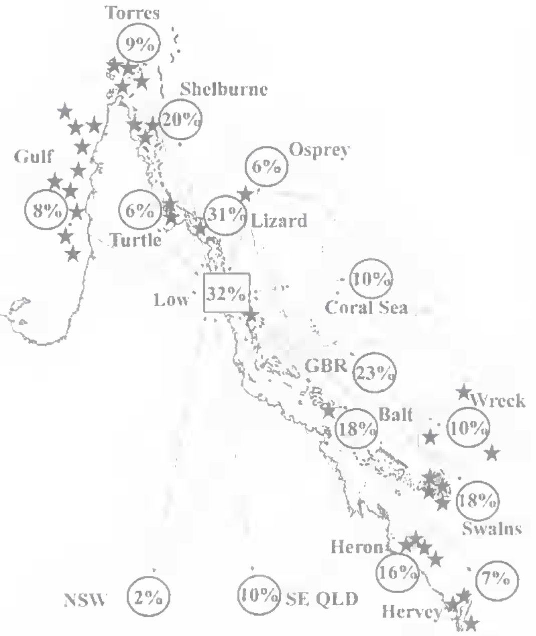

FIG. 3. Biogeographic comparisons in sponge diversity and species composition between the Low Isles and adjacent provinces (data from Hooper et al., 1999, this volume). Square = percentage of Low Isles species that are 'apparent endemics'; circles = percentage of Low Isles species also found in other provinces.

our re-examination of his material found that it did contain asters, and moreover was not conspecific with *J. stellifera*, differing significantly in growth form, surface features, skeletal structure, megasclere and microsclere dimensions from southern Australian populations. Burton's specimen appears to be a new species. Other authors have also recorded similar discrepancies. Bergquist and Warne (1980) found a 25% difference between Burton's spicule measurements from the holotype of *Callyspongia diffusa* and their own re-examination of this specimen. Burton also appears to have overemphasised the importance of external characters in identifying some of his material, overlooking other important skeletal characters. For example, his record of *Haliclona camerata* appears to be solely based on external features (growth form, surface features), whereas Ridley's (1884) holotype has a multispicular skeleton with spicules 25% larger than Burton's voucher specimen, which has a unispicular skeleton — again Burton's specimen appears to be a new species.

BIOGEOGRAPHY. A comparison of species diversity and composition between the Low Isles (including Burton's (1934) revised species list and our more recent QM collections), with sponge faunas of other reefs in the northern part of the GBR, indicate several patterns (Fig. 3).

1) 31 species (or 23% of the Low Isles fauna) are distributed throughout the GBR (annotated '3' on Table 1). These species were recorded on virtually every reef we have surveyed so far on the GBR, and they can be defined as a 'typical GBR sponge fauna'. Thus, the concept of a 'GBR sponge fauna' is partially substantiated.

Conversely, QM collections recorded several other species common throughout the GBR but notably absent from the Low Isles: *Acanthella costata*, *Amphimedon terpenensis* and another (new) species of *Amphimedon*, *Callyspongia carens* and several other *Callyspongia* spp., *Crella calypta*, *Echinochalina intermedia*, *Hippospongia elastica*, *Hyrtios erecta*, *Phakellia flabellata*, *P. klethra*, *Phyllospongia papyracea*, and several apparently undescribed species of *Dysidea*, *Haliclona*, *Niphates*, *Pericharax*, *Psammoclemma*, *Pseudoceratina* and *Siphonochalina*. In addition, the cryptic, cave-dwelling coral species *Levinella prolifera*, *Astrosclera willeyana*, *Acanthochaetetes wellsii*, *Sycetta* sp. and *Hypograntia* sp. are also absent from the Low Isles, probably because these specialised habitats are not present (e.g. Woerheide & Reitner, 1998).

2) Recent collections from Lizard Island, about 200km N of the Low Isles and closer to the outer barrier reef, found 176 species (Hooper et al., 1999, this volume). Of the Low Isles fauna 41 species (31%) are also found on Lizard I., with these two islands showing the highest affinities in their sponge faunas.

3) Recent collections from the adjacent northern coastal province (including fringing coral reefs, intertidal rock reefs, embayments and muddy reefs near the shore, extending along the Queensland coast from the Cooktown region into the Gulf of Carpentaria), found 142 species (Hooper et al., 1999, this volume). A comparison between the Low Isles sponges and this coastal fauna shows that only 17 species (13% of the Low Isles fauna) were common to both provinces (annotated '4' on Table 1). Furthermore, when considered separately each of these provinces usually had an even lower similarity in species composition: Gulf of Carpentaria (8% of Low Isles species), Torres Strait (9%), Shelburne Bay

including the Cockburn and Fast I. groups (20%), Turtle I. (6%) (Fig. 3). These data suggest that the Low Isles contain a greater proportion of 'coral reef species' than 'inshore coastal species', despite their closer proximity to the coast.

4) Recent collections of sponges from the coral reefs on seamounts in the Coral Sea (Osprey, Wreck, Cato and Saumerez Reefs), found 95 species (Hooper et al., 1999, this volume). A comparison between the Low Isles fauna and Coral Sea sponges shows that only 13 species (10% of the Low Isles fauna) were common to both provinces (annotated '5' on Table 1).

5) Only 4 species were found in all 3 regions (*Coscinoderma matthewsi*, *Halichondria* n.sp. #1227, *Myrmekioderma granulata*, and *Xestospongia testudinaria*).

6) Recent collections from the SE Queensland fauna (extending from Hervey Bay to Moreton Bay), found 233 species (Hooper et al., 1999, this volume). Comparisons with these SE Queensland faunas found only 14 species of Low Isles sponges (10% of the fauna) extended southward into this region: *Chondrilla australiensis, Echinodictyum mesenterinum, Ianthella basta, I. flabelliformis, Iotrochota foveolaria, Leucetta microraphis, Myrmekioderma granulata, Pericharax heterorhaphis, Phakellia cavernosa, Pseudaxinella australis, Xestospongia testudinaria* and 4 undescribed species of *Dysidea, Spirastrella, Timea* and *Clathria* (*Microciona*). Similarly, recent collections from N NSW (Byron Bay to Gold Coast) and S NSW (Sydney, Illawarra and Port Stephens regions) found 69 and 131 species from these regions, respectively (Hooper et al., 1999, this volume). Only 4 species living on the Low Isles also extend into S New South Wales.

7) A large number of species on the Low Isles are either 'apparent endemics' or have very restricted distributions here and on adjacent reefs. 43 species (32% of the Low Isles fauna) have not yet been found anywhere else, and another 22 (16%) are known only from the Low Isles and one other reef in the northern part of the GBR (mostly from Lizard Island). Thus, nearly 50% of the sponge fauna on the Low Isles is unique to this N GBR region.

It is possible that this high 'apparent species endemism' might be related to true regional endemism (such as the concept of a 'northern GBR fauna'). There is some empirical support for this through comparisons with S GBR reefs: 18% of Low Isles species were recorded on Bait and Hook Reefs (central GBR); 18% from the Swain Reefs (S GBR, outer reefs); and 16% from reefs in the vicinity of Heron I. (S GBR, inner reefs) (Fig. 3). It is also probable that some of this 'apparent endemism' is due to the heterogeneous distributions of many coral reef sponges (Hooper, 1994), perhaps related to particular habitat requirements and local geomorphological differences between individual reef systems (such as the availability of specialised habitats on particular reef systems).

COMMERCIAL 'BATH' SPONGES. Scientific investigation and commercial 'exploitation' of the Low Isles may have commenced as early as the 1890s, with the alleged introduction of commercial 'bath' sponge cuttings, apparently imported from the Mediterranean, seeded on the reef flat between the two islets ('Thalamita Flat' and 'Mangrove Park'). Surviving remnants (or decendents) of these populations are still common in this area, with some more-or-less 'organised' into vague rows. Burton (1934) identified this species as the Mediterranean *Spongia officinalis*. Its status as a possible remnant of a commercial 'sponge farm' is supported to some extent by our 1997 observations of its 'organised' distribution into 'vague rows' on the reef flat.

It is possible that Saville-Kent may have been responsible, directly or indirectly, for introducing these 'bath' sponges onto the Low Isles, given the popularity of 'translocating' exotic species during his era; he was also the Queensland Commissioner of Fisheries around this time (Harrison, 1997); and there is an anecdotal record of commercial sponge beds occuring on the Isles dating back to about the 1890s (Port Douglas Historical Society; pers. comm.). However, this evidence is inconclusive. It is more probable that these 'bath' sponge beds are remnants of the 'seeding experiments' conducted on the Low Isles and Murray Islands (Torres Strait) by Moorehouse during the GBR Expedition, and described in his report on the investigation of the potential viability of commercial sponge farming on the Great Barrier Reef (Moorhouse, 1933). Moorhouse noted that he made cuttings of wild populations of a 'black, dome-shaped *Hippospongia*', fitting the description of Burton's (1934) *S. officinalis*, which he seeded on the reef flat using various commercial methods of his day. This suggests that these commercial 'bath' sponges may be native to the GBR and not introduced, and therefore probably not conspecific with the Mediterranean *S. officinalis*. Re-examination of Burton's (1934) voucher specimen of *S. officinalis* from the Low Isles (Table 1) showed that it belonged to *Hippospongia* (our sp. #1983), and not to *Spongia*. This surviving population on the Low Isles possibly represents the first attempt at sponge culture on the GBR.

CONCLUSIONS

Patterns in species diversity and composition of Low Isles sponges (Fig. 3) indicate a greater proportion of both 'typical GBR species' and 'indigenous species' (most similar to Lizard I. than other reefs); only a small proportion of species shared with adjacent coastal and oceanic provinces; and very few species shared with more southern Australian provinces. In fact Burton (1934: 513) acknowledges that '[although] the sponges collected by the [GBR] Expedition belong ... to species characteristic of the Indo-Pacific ... many common to the coasts of Australia ... [with] mixing of the Australian and Malayan sponge-faunas ... this broad generalization [is] in itself inconclusive and unsatisfactory, [but] is the most that can be said'. He states further that comparison between the collections of the GBR Expeditions and those of Saville-Kent (the latter comprising an overwhelming number of indigenous species, but unfortunately with no locality data), suggests that generalizations about a 'GBR sponge fauna' based on the Low Isles species list are probably invalid. In this conclusion he is undoubtedly correct, given the peculiar nature of the Low Isles (inshore coastal reef), as compared with outer barrier reefs of the GBR in particular. However, to some extent there does appear to be a 'typical GBR sponge fauna' of about 20% of regional species' compositions, and some of these (perhaps up to 10%) are truly widely distributed throughout the Indo-west Pacific (although this latter estimate still lacks good empirical support). There is also indication that closer similarities between northern GBR reefs than with southern GBR reefs suggests the concept of a 'typical GBR fauna' may be too simplistic, and that the GBR itself comprises more than one province.

Burton's (1934) assumption that a significant number (12%) of GBR species may be 'cosmopolitan', also found in the West Indies, Azores and Mediterranean, is rejected. His voucher specimens of all these allegedly 'cosmopolitan' species are misidentifications. The concept of a generalised 'east coast Australian sponge fauna' (Lendenfeld, 1888, 1889; Burton, 1934) is also not supported (with the exception of 4 species). Nevertheless, despite the fact that 42% of Burton's species were misidentified, and only relatively few species were reported from the Low Isles themselves, Burton's (1934) report still stands as a valuable taxonomic contribution and a reasonable precis of faunal relationships of GBR sponges in general.

ACKNOWLEDGEMENTS

This study would not have been possible without the special permission of Great Barrier Reef Marine Park Authority (GBRMPA permit no. G96/005), to undertake extractive research from reefs of the Low Isles. Since the late 1800s the popularity of the Low Isles has led to inevitable environmental degradation. Consequently, GBRMPA and the Department of Environment proposed a strict plan of management for the Isles (Anon., 1993). Now implemented, the plan includes designated zones for specific use, a restriction of daily visitor numbers, and (more importantly) restrictions on the types of research activities now permitted. These latter restrictions include the curtailment of manipulative and extractive research (i.e. no collecting). The School of Marine Science, University of Queensland, now operates a small research station housed in some of the refurbished lighthouse buildings (Low Isles Research Station), with the intention to repeat the marine chemistry and physics experiments pioneered by the GBR Expedition. This present study was undertaken by the Queensland Museum in a similar spirit to revisit the pioneering work of Yonge, Burton and coworkers, and for this opportunity we are grateful to the Department of Environment and the Low Isles Preservation Society, Port Douglas. We are also grateful to the Department of Primary Industries, Fisheries, Cairns, for access to their facilities and charter of the FV 'Gwendolyn May'.

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TABLE 1. List of species collected from the Low Isles during the GBR Expedition 1928-29, described by Burton (1934), with revised nomenclature from re-examination of relevant BMNH voucher specimens, and list of species collected in 1997 by the QM. Key to codes: 1 = species collected by the QM from other reefs in the GBR but not found in our collections from the Low Isles. 2 = species reported by Burton from other more northerly reefs but not present in his Low Isles collection. 3 = species now known to be widespread throughout the Great Barrier Reef and some other Indo-west Pacific reefs. 4 = species found on both the Low Isles and the adjacent coast. 5 = species found on both the Low Isles and Coral Sea reefs. # = species identification presently unknown, possibly new, with unique QM species number indicated.

GBR Expedition 1928-29 collection from Low Isles (Burton, 1934)	BMNH voucher numbers	Revised name	QM 1997 collection from Low Isles
CALCAREA			
-	-	-	*Pericharax heteroraphis* Poléjaeff, 1884 (2,3,5)
Sycon gelatinosum (Blainville, 1834) (1)	1930.8.13.29a	*Sycon gelatinosum* (Blainville, 1834)	-
-	-	-	*Leucetta microraphis* Haeckel, 1872 (3,5)
ASTROPHORIDA			
Jaspis stellifera (Carter, 1879) (1)	1930.8.13.23a	*Jaspis* n.sp. (not *Jaspis stellifera* (Carter, 1879))	-
-	-	-	*Jaspis* n.sp. #2242
-	-	-	*Jaspis* n.sp. #1005
-	-	-	*Jaspis splendens* (de Laubenfels, 1954)
SPIROPHORIDA			-
Cinachyra australiensis (Carter, 1886)	1930.8.13.14a	*Cinachyra australiensis* (Carter, 1886)	*Cinachyra australiensis* (Carter, 1886) (3,5)
-	-	-	*Cinachyra* sp. #1870
-	-		*Cinachyrella* sp. #2270
-	-	-	*Raphidotethya enigmatica* Burton, 1934 (2,3,5)
-	-	-	*Raphidotethya* sp. #2045
HADROMERIDA			
Pseudosuberites andrewsi Kirkpatrick, 1900 (1)	1930.8.13.20a	*Pseudosuberites andrewsi* Kirkpatrick, 1900	-
-	-	-	*Suberites peleia* (de Laubenfels, 1954)
Laxosuberites proteus Hentschel, 1909	1930.8.13.111a	*Laxosuberites proteus* Hentschel, 1909	-
Polymastia megasclera Burton, 1934	1930.8.13.155a	*Polymastia megasclera* Burton, 1934	-
-	-	-	*Polymastia* sp. #2258
Tethya robusta Bowerbank, 1859 (1)	1930.8.13.199a	*Tethya robusta* Bowerbank, 1859	-
-	-	-	*Tethya coccinea* Bergquist & Kelly-Borges, 1991
-	-	-	*Tethya* sp. #2249
-	-	-	*Timea* sp. #1389
Spirastrella inconstans (Dendy, 1887) (1,3)	missing	*Spirastrella inconstans* (Dendy, 1887) (some description provided)	-
Spirastrella aurivillii Lindgren, 1897 (1)	missing	? (no description provided)	-
-	-	-	*Spirastrella* sp. #1385
-	-	-	*Chondrilla australiensis* Carter, 1873 (2,3)
Chondrilla nucula Schmidt, 1862	1930.8.13.23a	*Chondrilla* cf. *nucula* Schmidt, 1862	-
-	-	-	*Chondrilla* sp. #492
HAPLOSCLERIDA			
Haliclona camerata (Ridley, 1884) (1,3)	1930.8.13.60a	*Haliclona* sp. (not *Haliclona camerata* (Ridley, 1884))	-
Haliclona clathrata (Dendy, 1895)	1930.8.13.57	*Reniera* sp. (not *Haliclona clathrata* (Dendy, 1895))	-
Haliclona exigua (Kirkpatrick, 1900)	1930.8.13.53a	*Xestospongia exigua* (Kirkpatrick, 1900)	*Xestospongia exigua* (Kirkpatrick, 1900) (3)
Haliclona pigmentifera (Dendy, 1905) (1)	1930.8.13.55a	*Haliclona* sp. (not *Haliclona pigmentifera* (Dendy, 1905))	-

Haliclona tenuispiculata Burton, 1934	1930.8.13.59a	*Haliclona tenuispiculata* Burton, 1934	-
-	-	-	*Haliclona* sp. #1954 (5)
-	-	-	*Haliclona* sp. #2246
-	-	-	*Haliclona* sp. #2247
-	-	-	*Haliclona* sp. #2248
Adocia fibulatus var. *microsigma* Dendy, 1916	missing	*Haliclona cymaeformis* (Esper, 1791) (no description but ID probable from Burton's remarks)	*Haliclona cymaeformis* (Esper, 1791) (3)
-	-	-	*Haliclona* (*Toxadocia*) sp. #2253
Adocia toxius (Topsent, 1897)	1930.8.13.38a	*Haliclona* sp. (not *Haliclona toxius* (Topsent, 1897)	-
Adocia minor (Dendy, 1916) (1)	1930.8.13.62a	*Adocia* sp. (not *Haliclona minor* (Dendy, 1916))	-
Adocia pumila (Lendenfeld, 1887) (1)	1930.8.13.32a	*Gelliodes pumilus* (Lendenfeld, 1887)	-
Adocia sagittaria (Sollas, 1902)	1930.8.13.40a	*Oceanapia sagittaria* (Sollas, 1902)	*Oceanapia sagittaria* (Sollas, 1902)
-	-	-	*Aka* sp. #1373
-	-	-	*Aka* sp. #2254
-	-	-	*Aka* sp. #2255
-	-	-	*Aka* sp. #2259
-	-	-	*Gelliodes* sp. #1215
-	-	-	*Gelliodes* sp. #2244
-	-	-	*Gellius* sp. #2269
-	-	-	*Niphates* sp. #2245
Callyspongia diffusa (Ridley, 1884) (1)	1930.8.13.47a	*Callyspongia* (*Euplacella*) *diffusa* (Ridley, 1884)	-
Callyspongia ridleyi Burton, 1934 (1)	1930.8.13.165a	*Callyspongia ridleyi* Burton, 1934	-
-	-	-	*Callyspongia* sp. #981
Oceanapia fistulosa (Bowerbank, 1873) (1)	1930.8.13.50a	*Oceanapia* sp. (not *O. fistulosa* (Bowerbank, 1873)	-
Oceanapia reneiroides Burton, 1934	1930.8.13.49a	*Oceanapia reneiroides* Burton, 1934	*Oceanapia renieroides* Burton, 1934
-	-	-	*Petrosia* sp. #2252
-	-	-	*Strongylophora* sp. #1580
-	-	-	*Xestospongia testudinaria* (Lamarck, 1815) (3,4,5)
-	-	-	*Xestospongia nigricans* (Lindgren, 1897)
-	-	-	*Xestospongia pacifica* Kelly-Borges & Bergquist, 1988 (3,5)
POECILOSCLERIDA *Desmapsamma anchorata* (Carter, 1882) (1,3)	1930.8.13.151a	*Ceratopsion* n.sp. (Raspailiidae)	-
-	-	-	*Desmapsamma* sp. #1528
Iotrochota purpurea (Bowerbank, 1875)	1930.8.13.90a	*Iotrochota foveolaria* (Lamarck, 1814)	*Iotrochota foveolaria* (Lamarck, 1814) (4)
-	-	-	*Iotrochota* sp. #377
-	-	-	*Iotrochota* sp. #2256
-	-	-	*Iotrochota* sp. #2263
Clathria aculeata Ridley, 1884	1930.8.13.93a	*Clathria* (*Thalysias*) *abietina* (Lamarck, 1814)	*Clathria* (*Thalysias*) *abietina* (Lamarck, 1814)
Tenacia coralliophila (Theile, 1903)	1930.8.13.107	*Clathria* (*Thalysias*) n.sp. (not *Clathria* (*Thalysias*) *coralliophila* (Thiele, 1903))	-
-	-	-	*Clathria*(*Thalysias*) *cervicornis* (Thiele, 1903)
-	-	-	*Clathria* (*Thalysias*) *lendenfeldi* Ridley & Dendy, 1886 (4)
-	-	-	*Clathria* (*Thalysias*) *tingens* Hooper, 1996
-	-	-	*Clathria* (*Thalysias*) *vulpina* (Lamarck, 1814) (2,3,4)

Ophlitaspongia rimosa (Ridley, 1884) (1)	1930.8.13.17a	*Clathria (Isociella) eccentrica* (Burton, 1934)	-
Ophlitaspongia eccentrica Burton, 1934	1930.8.13.109a	*Clathria (Isociella) eccentrica* (Burton, 1934)	*Clathria (Isociella) eccentrica* (Burton, 1934)
-	-	-	*Clathria (Microciona)* n.sp. #1882
-	-	-	*Clathria (Microciona)* n.sp. #2265
-	-	-	*Echinochalina (Echinochalina) tubulosa* (Hallmann, 1912) (4)
-	-	-	*Raspailia (Raspaxilla) reticulata* Hooper, 1991
-	-	-	*Echinodictyum mesenterinum* (Lamarck, 1814)
-	-	-	*Endectyon elyakovi* Hooper, 1991
-	-	-	*Raspailia (Raspaxilla)* n.sp. #2264
-	-	-	*Thrinacophora* n.sp. #1993 (5)
-	-	-	*Biemna* sp. #2260
-	-	-	*Coelocarteria singaporensis* (Carter, 1883) (2,3,4)
-	-	-	*Crella* sp. #2243
-	-	-	*Strongylacidon* sp. #1533
-	-	-	*Zyzzya* sp. #1653
HALICHONDRIDA			
-	-	-	*Acanthella* n.sp. #1562
-	-	-	*Auletta constricta* Pulitzer-Finali, 1982 (3)
-	-	-	*Axinella* n.sp. #2267
-	-	-	*Axinella carteri* (Dendy, 1889) (3,4)
-	-	-	*Axinyssa* n.sp. #2257
-	-	-	*Cymbastela concentrica* (Lendenfeld, 1887) (3)
-	-	-	*Cymbastela coralliophila* Hooper & Bergquist, 1992 (3)
-	-	-	*Phakellia cavernosa* (Dendy, 1921) (2,3,4)
-	-	-	*Pseudaxinella australis* Bergquist, 1970 (3)
-	-	-	*Reniochalina* cf. *stalagmitis* sp. #417 (4)
-	-	-	*Reniochalina stalagmitis* Lendenfeld, 1888 (4)
Leucophloeus fenestratus Ridley, 1884 (1)	1930.8.13.153a	*Ciocalypta fenestratus* (Ridley, 1884)	-
-	-	-	*Ciocalypta* n.sp. #2251
-	-	-	*Halichondria* sp. #1227 (4,5)
-	-	-	*Halichondria stalagmites* (Hentschel, 1912)
-	-	-	*Hymeniacidon* n.sp. #2261
-	-	-	*Myrmekioderma granulata* (Esper, 1830) (3,4,5)
-	-	-	*Liosina paradoxa* (Thiele, 1899) (3)
DICTYOCERATIDA			
Phyllospongia dendyi Lendenfeld, 1889	1930.8.13.199a	*Lendenfeldia plicata* (Esper, 1806)	-
Carteriospongia foliascens (Pallas, 1766)	1930.8.13.203a	*Carteriospongia foliascens* (Pallas, 1766)	*Carteriospongia foliascens* (Pallas, 1766) (3)
-	-	-	*Coscinoderma mathewsi* (Lendenfeld, 1886) (3,4,5)
Spongia officinalis Linnaeus, 1759	1930.8.13.188a	*Hippospongia* sp. (not *S. officinalis* Linn.)	*Hippospongia* sp. #1983 (5)
-	-	-	*Spongia* cf. *officinalis* Linnaeus sp. #262 (3)
-	-	-	*Dactylospongia elegans* (Thiele, 1899) (3,5)
-	-	-	*Ircinia* sp. #1534
-	-	-	*Ircinia* sp. #1876 (5)
-	-	-	*Ircinia* sp. #2268
-	-	-	*Ircinia* cf. *ramosa* #1377

-	-	-	*Psammocinia* sp. #487
	-		*Fascaplysinopsis* sp. #2170
-	-	-	*Fascaplysinopsis reticulata* (Hentschel, 1912) (3,5)
Dysidea herbacea (Keller, 1889)	1930.8.13.175a	*Dysidea herbacea* (Keller, 1889)	*Dysidea herbacea* (Keller, 1889) (3)
-	-	-	*Dysidea* sp. #229 (4)
-	-	-	*Dysidea* sp. #1214
-	-	-	*Dysidea* sp. #2250
-	-	-	*Dysidea* sp. #2262
-	-	-	*Dysidea* sp. #2266
VERONGIDA			
-	-	-	*Aplysinella rhax* (de Laubenfels, 1954) (3)
Druinella purpurea (Carter, 1880)	1930.8.13.198a	*Druinella purpurea* (Carter, 1880)	*Druinella purpurea* (Carter, 1880) (3)
-	-	-	*Pseudoceratina* sp. #1565
-	-	-	*Pseudoceratina* sp. #2196
-	-	-	*Pseudoceratina* sp. #2399
-	-	-	*Ianthella basta* (Pallas, 1766) (4)
-	-	-	*Ianthella* cf. *flabelliformis* sp. #196 (4)
-	-	-	*Ianthella flabelliformis* Pallas, 1766) (2,3,4)
TOTAL BURTON SPECIES = 36 spp. (5 new)		15 misidentified spp., 1 sp. uncertain, 14 revised generic assignments	TOTAL QM SPECIES = 109 spp (61 spp. unnamed possibly new)
Comparison between Burton & QM collections = 12 spp. in common. Total Low Isles fauna: 134 species, 63 genera, 35 families.			

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NEW DATA ABOUT MORPHOLOGY AND FEEDING PATTERNS OF BARENTZ SEA *HALICHONDRIA PANICEA* (PALLAS). *Memoirs of the Queensland Museum 44: 262. 1999*:- Visual observations in the marine aquaria and transmission electron microscopy studies on the larvae of the intertidal sponge *Halichondria panicea* demonstrated individual variations in external and internal morphology, behaviour and type of metamorphosis. Parenchymulae of this species were found to possess the ability to actively feed by endocytosis (phago- and pinocytosys). The larvae crawled over the substrate and cast numerous unicellular organisms (bacteria and flagellates from 2 - 4μm in size) onto the body surface by a flagellum. During this, the apical parts of the flagellated cells formed large lobopodia that served for catching and ingesting food particles. I monitored the consequent patterns of contact of the flagellates with the surface of lobopodia, their entrapment, submersion, the formation and transport of the digestive phagosomes into the basal parts of the surface cells. Each surface locomotory cell was capable of catching and ingesting food. No morphological and/or functional differences between the surface cells were found. Nevertheless, singular flagellated cells packed with the phagosomes submerged inside the larva. Here these cells could be easily distinguished by the presence of a flagellum and the typical shape of the nucleus. Later on, the submerged flagellated cells withdrew the flagellum and acquired an amoeboid shape. Final digestion of the caught organisms occurred only inside the larva. It was suggested that endosymbionts found in the surface and inner cells of the larvae served as an additional food source for the larvae. Presence of the numerous pinocytosis vacuoles in the apical parts of the flagellated cells suggested that the sponge larvae are also able to absorb dissolved low-molecular matter.

To conclude, parenchymula of *H. panicea* could be recognised as a living embodiment (a living model) of the hypothetical phagocytella of Mechnikov in which the differentiation of the body layers into kinoblast and phagocytoblast is only primordial, purely functional and still reversible. ☐ *Porifera, intertidal, larva, feeding, digestion, endocytosis, digestive phagosomes, Halichondria panicea.*

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